Sjournals
Scientific Journals
Scientific Journal of Biological Sciences (2013) 2(6) 105-111
ISSN 2322-1968

Contents lists available at Sjournals
Scientific Journal of
BiologicalSciences
Journal homepage: www.Sjournals.com

Original article

Effect of feeding rate on the survival and growth of *Clarias gariepinus* fry weaned from zooplankton and *Artemia*

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ARTICLE INFO

Article history:
Received 29 May 2013
Accepted 18 June 2013
Available online 28 June 2013

Keywords:
Commercial
Multifeed
Dietary treatments
Specific growth Rate

ABSTRACT

Commercial (Multifeed) diets were fed to *Clarias gariepinus* fry earlier weaned from decapsulated Artemia and dried mixed-cultured zooplankton at (3% and 5%) feeding rates each for 21 days, to assess fry survival and growth on the two feeding rate. Dietary treatments were in triplicate, in a completely randomized design. Fry were randomly distributed into 12 aerated, 30litres plastic tanks at a stocking rate of 30 fry per tank. The best percent survival (40.00±31.80) which was not statistically (P>0.05) significant from other treatments was in the fry fed commercial feed at 3% feeding rate, which were weaned on zooplankton. Specific growth rate was not significantly (P>0.05) different but higher (6.37±0.91) in the fry fed commercial feed at 5% feeding rate, earlier fed *Artemia* at 5% feeding rate. FCR, GFCE, and FE of fry fed commercial feed at 3% feeding rate, which were earlier fed zooplankton, were the best with no significant (P>0.05) differences among the four treatments. The study revealed that the fry earlier fed decapsulated *Artemia* and those fed dried mixed cultured freshwater zooplankton could be weaned on commercial feed at 3% and 5% feeding rates, with no significant (P<0.05) difference on the fry growth, survival and feed conversion.

1. Introduction

The importance of aquaculture in improving the diet of people, generating employment in rural areas and saving foreign exchange through import substitution has generally been recognized in most African countries (Okoye, 1986). *Clarias gariepinus* is considered to be one of the most important tropical catfish species for aquaculture and has since the 1970's, been considered a fish of great promise for fish farming in Africa (Faruque *et al*., 2010). The mass propagation of this species is maximized through hatchery operation with high production per unit area. One of the major challenges in the hatchery management is the provision of adequate and appropriate feed for the fish hatchlings (Ezechi and Nwuba, 2007). This research examines the influence of feeding rates of commercial diet on survival and growth performance of fry earlier weaned on dried freshwater zooplankton and Artemia.

2. Materials and methods

The feeding experiment was conducted at the Fish Hatchery of the Department of Forestry and Fisheries on latitude 13^0 07' 78''N and longitude 050 12'25''E at 275m above sea level (Google Earth, 2011), at the permanent site of Usmanu Danfodiyo University, Sokoto, Nigeria.

2.1. Experimental setup

Fry earlier fed on zooplankton and Artemia and weaned on commercial (Multifeed) diet, each fed at 3% and 5% of fry body weight, constituted the four treatments of the experiment, and each treatment was replicated three times in a completely randomized design (CRD). Twelve 30litre capacity plastic bowls (experimental unit) were used for the feeding experiment, with 30 larvae stocked in each. The initial weight and standard length of the fish for each experimental unit were measured using JT 210N series electronic top loading balance of two digits and a plastic ruler (cm). The proximate composition of the diet is illustrated in Table 1. The diet was fed directly. Feeding each group was thrice daily, in the morning (7:00-8:00am), afternoon (1:00-2:00pm), and evening (6:00-7:00pm). Remains of feed were siphoned out of the culture medium before feeding and same quantity of water removed during siphoning was replaced immediately. Total renewal of whole water was done every three days, and the bowls bottoms were scrubbed to remove dirt from the medium. The survival and mortality rates were monitored on daily basis. The weight and the total length of the fry were taken at intervals of 7 days. Two water quality parameters (pH and temperature ^{0}C) were monitored in the morning, afternoon and evening daily.

2.2. Data analysis tools

Data collected on survival rate, body weight and length, feed fed, water temperature and pH were analyzed as follows;

Percent Survival Rate (S) was calculated (NACA, 1989) as:

$$S\ \% = \frac{number\ of\ fry\ stocked\ at\ the\ beginning\ of\ the\ \mathrm{exp}eriment}{number\ of\ fry\ alive\ at\ the\ end\ of\ the\ \mathrm{exp}eriment} \times 100$$

Weight Gain (WG) and Percent Weight Gain (PWG), were computed following the procedures as in Sveier *et al.*, (2000):

(WG) = Final weight (g) – Initial weight (g).

$$\text{PWG} = \frac{Final\ weight\ (g)\ -\ Initial\ weihgt\ (g)}{Initial\ weight} \times 100$$

Specific Growth Rate (SGR), was calculated as described by Castell and Tiewes (1980):

$$SGR\ \% = \frac{\log_e w - \log_e i}{time\ (\text{days})} \times 100$$, where

Log_e = Natural logarithm

W_i = initial weight (g) of fish at the beginning of experiment.

W_f = final weight (g) of fish at the end of the experiment.

Feed Conversion Ratio (FCR) and Food Efficiency (FE), were computed as in NACA (1989):

$$FCR = \frac{Diet\ fed\ (g)}{Weight\ gained\ (g)}$$

$$FE = \frac{Weight\ gain\ (g)}{Feed\ consumed(g)}$$

Condition Factor (K)

Condition Factor (K) of the fry was calculated following the procedure of Bagenal and Tesch (1987)

$$K = \frac{100W}{L^3}$$

where

W = weight of fish (g)

L = standard length of fish (cm).

2.3. Statistical analysis

Data collected on growth, survival and feed utilization were subjected to analysis of variance (ANOVA) and means were separated using New Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984). Computer analysis was carried out using the SPSS Version: 16.0 (2007) package for windows.

3. Results and discussion

The results (Table 2) showed that the highest percent survival rate (40.00±31.8) was in the fry weaned from (WF) zooplankton and fed commercial feed, at 5% feeding rate, while the least (8.88±6.94) was in the group weaned from *Artemia* and fed on artificial diet at 3% feeding rate. Statistical analysis showed that the survival rates of the four treatments were not significantly (P>0.05) different. Fig. 1 illustrates the trend of fry survival in the different dietary treatments and showed that the mortality rate increased as the experiment progressed.

The final weight of fry placed on the different feeding rates were not significantly different (P>0.05), but highest (0.172±0.09) in fry weaned from zooplankton at 3% and fed on artificial diet at 3% feeding rate. The mean weight gain was also higher in the fry weaned from zooplankton at 3% feeding rate and fed commercial feed at 3% feeding rate, followed by those weaned on zooplankton at 5% feeding rate and fed commercial feed at 5% feeding rate. However, there was no significant difference (P>0.05) between the treatments in the final weight and the mean weight gain of the four dietary treatments. This indicates that the fry fed commercial feed at 3% feeding rate earlier fed dried zooplankton at 3% feeding rate, compared favourably with those fed *Artemia* when both were weaned on commercial diet.

The percent weight gain (287.45±178.57) was highest in the group fed the commercial feed at 3% feeding rate earlier weaned from zooplankton, while the specific growth rate was highest (6.37±0.91) in those fed 5% commercial feed earlier fed 5% *Artemia*. However, they were not significantly (P>0.05) higher than the values recorded for the other treatments this indicates similarity in growth response to the commercial diets.

Fig. 2 illustrates the trend of the body weight of the fry during the period of the experiment. The body weight of fish placed on the four dietary treatments increased steadily in the first two weeks of the experiment (Fig 2). In the third week, fry earlier weaned from *Artemia* decreased.

The best condition factor (3.32±0.09) was recorded in the fry weaned from zooplankton fed commercial feed at 3% feeding rate while the least (1.31±0.78) was in the group weaned from zooplankton and fed commercial feed at 5%.

The feed conversion ratio was best (0.46±0.23) in the fry fed 3% commercial feed and earlier on zooplankton at 3% feeding rate (Table 3). The worst (1.23±0.93) was obtained in the group fed commercial feed at 5% feeding rate earlier weaned from zooplankton at 5% feeding rate. However, there was no significant (P>0.05) difference in the FCRs of the four dietary treatments. Also there were no significant difference in the gross food conversion efficiency (GFCE) and the feed efficiency (FE) of the four treatments.

The results of the water temperature and pH monitored during this period of experiment are summarized in Table 4. The morning temperature varied from 22.0 to 25.4^{0}C, with the mean value (23.7±1.70^{0}C) while the afternoon temperature varied from 25.5 to 29.5^{0}C, with the mean value (27.5±20^{0}C). The maximum and minimum evening temperature was 22.8 and 26.9^{0}C, respectively with the mean 24.9±2.1^{0}C. The overall mean temperature was 25.4±1.95^{0}C.

The overall mean of the water pH during the experimental period was 7.65±0.23 (Table 4). It varied from 7.43 to 7.87, with mean of 7.65±0.23 in the morning, 7.44 to 8.01 with mean value of 7.72±0.30 in the afternoon and 7.31 to 7.78, with a mean of 7.55±0.24 in the evening.

The trend in the daily temperature during the experiment illustrated in Fig. 3 showed that it decreased gradually from the initial week to the last week of the experiment. The results of the survival rates of fry on various dietary treatments (Fig. 1) indicated high rate of mortality leading to poor survival towards the end of the experimental period in all the dietary treatments. This was not due to the dietary treatments but rather, the effect of sudden fluctuation and reduced water temperature in all the experimental units (Fig 3), below the optimum temperature requirement for *Clarias gariepinus*. It is known that warm water fish grow best in temperatures between 25^{0}C and 30^{0}C (Boyd and Lichtcoppler, 1979; Viveen *et al*., 1985). The low morning temperature (22.0^{0}C), and sudden temperature rise (29.5^{0}C) in the afternoon and temperature (22.8^{0}C) fall in the evening, may have resulted in low feed intake; emergence of shooters, where survival was a little high very tiny fry dominated; water became fouled within short time of feeding, indicating low feed intake; and subsequently reduction in weight gain; deterioration of the culture medium during the experimental period; and death of fry. This is in line with the report of Boyd and Lichtcoppler (1979), who stated that a 5% sudden change in temperature could stress or even kill fish.

The results of the survival, growth and feed conversion indicate that fry weaned on dried mixed cultured zooplankton after yolk absorption, and later fed commercial feed compete favourably with those weaned on Artemia and latter fed commercial feed when fed without significant different.

4. Conclusion

The findings on survival and growth of *C. gariepinus* fry on commercial feed, revealed that the fry fed decapsulated *Artemia* and those fed dried mixed cultured freshwater zooplankton could be weaned on commercial feed at 3% and 5% feeding rates, with no significant (P<0.05) difference on the fry growth, survival and feed conversion.

The growth and survival of the fry were highly affected by sudden fluctuations and fall in temperature below the optimum temperature requirement for *Clarias gariepinus* survival. This underscores the need for appropriate timing for raising fry in the study area and the need for control measures in such environment.

Table 1
Proximate composition of commercial feed (Multifeed^{MT}).

Parameter	% composition
Ash	12.0
Fat	1.5
Fibre	2.0
Crude protein	53
Phosphorus	1.5
Calcium	1.5

Source: multifeed^{MT} complete dry fish food, Israel.

Table 2
Growth performance of *Clarias gariepinus* fry fed commercial feed (Multifeed).

Parameter	Diet/treatment			
	Artemia		Zooplankton	
	(3%WF*Artemia*) 3% of commercial diet	(5%WF*Artemia*) 5% of Commercial diet	(3%WFZooplankton) 3% of Commercial diet	(5%WFZooplankton) 5% of commercial diet
Experiment period/day	21	21	21	21
Total initial fish number	90	90	90	90
Total final fish number	8	18	14	36
Average initial weight (g)	0.041	0.038	0.043	0.040
Average final weight (g)	0.123±0.03	0.151±0.03	0.172±0.09	0.154±0.12
Percent survival rate	8.88±6.94	20.00±5.77	15.56±15.75	40.00±13.80
Mean weight gain (g)	0.07±0.03	0.11±0.03	0.13±0.09	0.11±0.12
Mean percent weight gain	122.9±50.9	286.18±69.5	287.45±178.6	283.17±291.4
Mean specific growth rate (%/day).	3.74±1.04	6.37±0.91	6.13±2.10	5.50±3.54
Mean initial length (cm)	1.07±0.17	1.04±0.3	1.05±0.17	1.04±0.18
Mean final length (cm)	2.33±0.61	2.12±0.41	1.9±0.26	2.22±0.13
Mean increase in length (cm)	1.26±0.46	1.08±0.25	0.85±0.13	1.18±0.46
Percent increase in length	117.75±46.10	103.85±25.91	80.95±15.69	113.46±25.10
Condition factor	1.38±0.80	1.84±1.22	3.16±3.08	1.31±0.78

Means in rows are not significantly different (P>0.05)
WF= *weaned from*

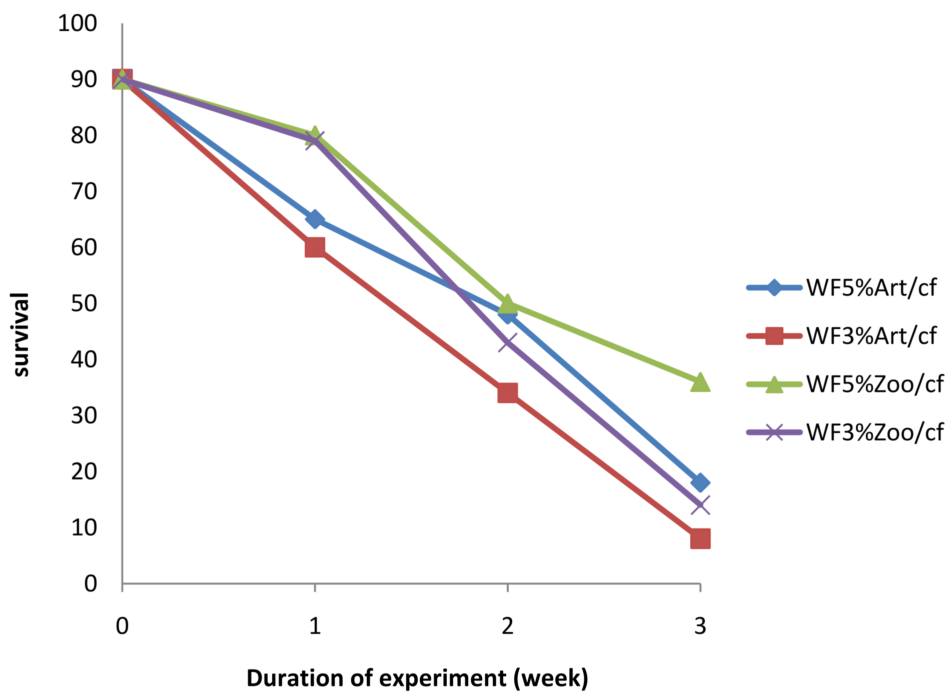

Fig. 1. Survival of *C. gariepinus* during the experiment on commercial feed.

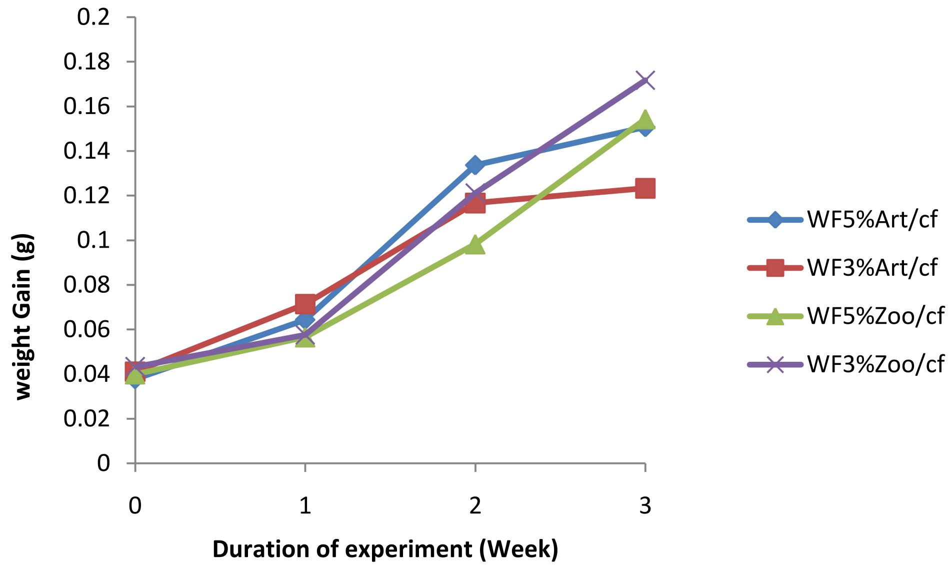

Fig. 2. Increase in length of *Clarias gariepinus* fry during the experiment on commercial feed.

Table 3
Feed utilization of *Clarias gariepinus* fry fed commercial feed (Multifeed).

Parameter	**Diet/Treatment**			
	Artemia		**Zooplankton**	
	3% of Commercial diet WF 3% Artemia	**5% of Commercial diet WF 5% Artemia**	**3% of Commercial diet WF 3% Zooplankton**	**5% of Commercial diet WF 5% Zooplankton**
Experimental periods (day)	21	21	21	21
Mean total quantity feed fed (g)	0.06±0.02	0.10±0.04	0.05±0.01	0.08±0.02
Feed conversion ratio	0.92±0.42	0.90±0.28	0.46±0.23	1.23±0.93
Gross feed conversion efficiency (%)	125.51±61.05	118.20 ±33.49	262.052±144.99	136.02±120.87
Feed efficiency	1.26±0.61	1.18±0.33	2.62±1.45	1.36±1.21

Means in rows are not significantly different ($P>0.05$).

Table 4
Water temperature and pH during growth and survival of fry on commercial feed (Multifeed).

Parameter		**Morning**	**Afternoon**	**Evening**	**Overall mean**
Temperature (^{0}C)	Minimum	22.0	25.5	22.8	23.4±1.75
	Maximum	25.4	29.5	26.9	27.3±1.18
	Mean ± SE	23.7±1.70	27.5±20	24.9±2.1	25.4±1.95
pH	Minimum	7.42	7.42	7.31	7.38 ±0.04
	Maximum	7.88	8.01	7.78	7.89±0.07
	Mean ± SE	7.65±0.23	7.72±0.30	7.55±0.24	7.64±0.26

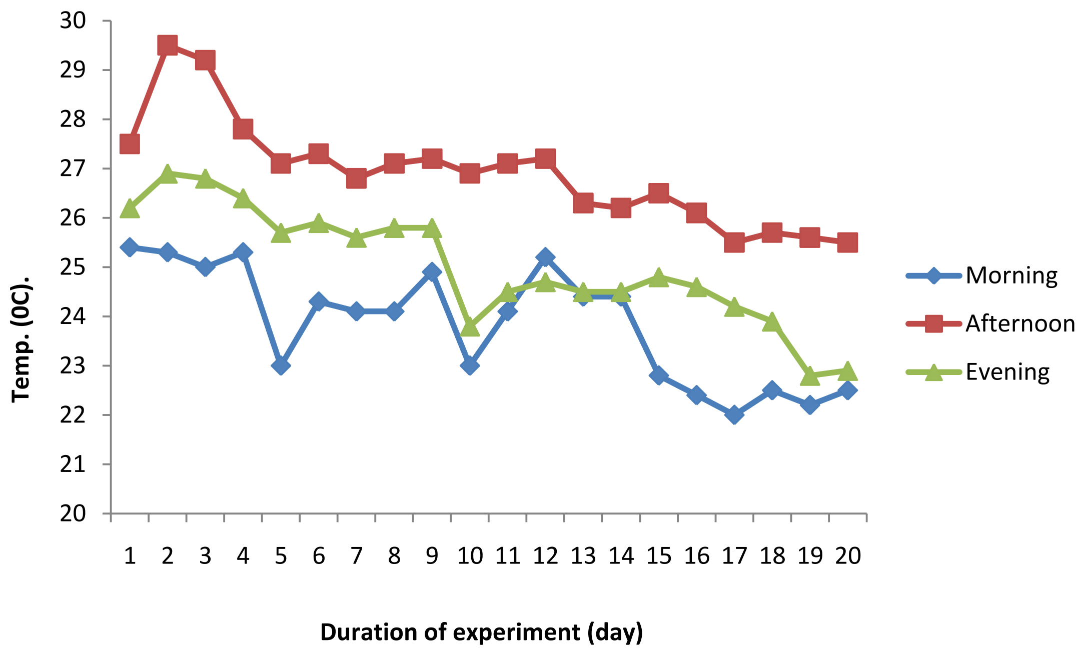

Fig. 3. Water temperature during the experiment on commercial feed.

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